

USC 357
21 Calif

TWO QUASI-STELLAR RADIO SOURCES WITH LARGE REDSHIFTS

Two more redshifts of quasi-stellar radio sources have been determined at the Lick Observatory. They are given in Table 1, together with the spectral line identifications on which they are based. The prime-focus spectrograph on the 120-inch telescope was used, with both cameras and both Schmidt correctors for the short focal-length camera, and the plates used were Eastman Kodak 080-01, 081-01, 103a-D, 103a-F, and baked IIA-0.

The radio source 3C 208, (Edge, Shakeshaft, McAdam, Baldwin, and Archer 1959), was identified with a blue stellar object by Sandage and Wyndham (1965), and the position and a finding chart were kindly provided by Allan Sandage before publication.

The source 0106+01 is from the Parkes catalogue (Day, Shimmins, Ekers, and Cole 1965) and the identification with a blue stellar object was made by Bolton, Clarke, Sandage, and Véron (1965). In this case also, the position and a finding chart were kindly provided before publication, by John Bolton.

The object 0106+01 has $m_v = 18.39$ (Bolton et. al. 1965). The line at 3776 \AA was measured on two spectra taken with the F/0.5 camera; it is about 70 \AA wide, and is identified with $\text{Ly-}\alpha$. The second line, at 4819 \AA , was measured on the spectrum taken on IIA-0 emulsion, which is reproduced in Figure 1 (the other spectrum was taken on the new special Kodak 080-01 emulsion which drops in sensitivity toward longer wavelengths more steeply than IIA-0, so that it did not extend far enough to provide a check on this line). This line is identified with C IV 1550. One spectrum only was taken in the red wavelength region, on Kodak new special E emulsion (081-01), which is grainy but very fast. A feature was measured at 5935 \AA ; this appears to be due to C III] 1909 (using the notation of Osterbrock and Parker (1965) for lines that

are partially forbidden

FACILITY FORM 602

N67-80017

(ACCESSION NUMBER)

(PAGES)

(NASA CR OR TMX OR AD NUMBER)

(THRU)

(CODE)

(CATEGORY)

The object 3C 208 has $m_v = 17.42$ (Sandage and Wyndham 1965). The first Lick spectra were obtained in March, 1964, in the red and yellow spectral regions, and no undoubted spectral features were detected. Spectra taken with the F/1 camera in the blue clearly showed the line at 4027 \AA , but this was the only certain line that was seen. A spectrum taken in November, 1965, with the new quartz corrector and F/0.5 camera on baked IIA-0 emulsion showed an additional line near 4900 \AA , which may have structure in it. This spectrum is also reproduced in Figure 1.

The ratio of the wavelengths of these two lines is 1.218. Following the procedure used by Schmidt (1965) in making identifications, we find 6 possible line pairs that give ratios between 1.213 and 1.223. They are:

H ϵ 3889/He II 3203; [O III] 2322/C III] 1909; C II] 2326/C III] 1909;

Si II 1815/ N IV 1488; He II 3203/[Mg VII] 2626; and [O III] 5007/H δ 4102.

Of these, the best-fitting pair is C II] 2326/C III] 1909 which gives 1.219; this is also the most reasonable identification on the basis of the non-appearance of other features. The C II] 2326 line has not been previously identified in quasi-stellar objects, but Osterbrock and Parker (1965) have predicted that it should be present. If the redshift in Table 1 is correct, then Mg II 2798 should be visible near 5900 \AA . On the spectra taken in the red, the night sky Na I D lines are very strong at 5893 \AA , but an underlying broad emission was suspected to be present. A doubtful feature at 6252 \AA was also measured; it might be [Ne V] 2973.

The redshift of 2.107 for 0106+01 in Table 1 is slightly larger than that of 3C 9 (Schmidt 1965), and the same two lines are seen as Schmidt observed in 3C 9, but C III] 1909 appears to be present also. As in 3C 9, there is plenty of radiation visible on the short wavelength side of Ly- α ; whether there is any drop in the continuum will have to be settled by spectrum scanner measurements.

~~ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED~~
~~DATE 11-11-81 BY SP-6 JRS/STW~~
~~EXEMPT FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION~~

The similarity between 0106+01 and 3C 9 is demonstrated by a comparison between Figure 1 and the spectrum of 3C 9 in the paper by Burbidge (1965) which was also taken with the Lick 120-inch telescope and prime-focus spectrograph, although different cameras were used. Both objects have the same visual magnitude.

This work has been supported in part by a grant from the National Science Foundation and in part by NASA through Grant No. NSG-357.

E. MARGARET BURBIDGE

December 7, 1965

UNIVERSITY OF CALIFORNIA AT SAN DIEGO

REFERENCES

- Bolton, J. G., Clarke, M. E., Sandage, A., and Véron, P. 1965, Ap. J., 142, 1289.
- Burbidge, E. M. 1965, Ap. J., 142, 000.
- Day, G. A., Shimmings, A. J., Ekers, R. D., and Cole, D. J. 1965, Austr. J. Physics, (in press).
- Edge, D. O., Shakeshaft, J. R., McAdam, W. B., Baldwin, J. E., and Archer, S. 1959, Mem. R.A.S., 68, 37.
- Osterbrock, D. E. and Parker, R. A. R. 1965, preprint.
- Sandage, A. R. and Wyndham, J. D. 1965, Ap. J., 141, 328.
- Schmidt, M. 1965, Ap. J., 141, 1295.

TABLE 1

MEASURED WAVELENGTHS, IDENTIFICATIONS, AND REDSHIFTS

	$\lambda_{\text{measured}}$	Ident.	λ_0	z
3C 208	4027	C III]	1909	1.109
	4904	C II]	2326	1.108
Adopted mean z = 1.109				
0106+01	3776	Ly- α	1216	2.105
	4819	C IV	1550	2.109
	5935	C III]	1909	2.109
Adopted mean z = 2.107				

FIGURE CAPTION

Fig. 1 Spectra of 3C 208 and 0106+01 in the photographic region. Wavelengths of two comparison lines from the He-Ar glow tube are marked for reference; the strong lines across the whole object window are Hg from the San Jose night sky. Two broad emission lines in each object are marked with their wavelengths.